CLAIMS

1. An article comprising: a sample exposure region, and a nanowire, at least a portion of which is addressable by a sample in the sample exposure region.

2. The article as in claim 1, further comprising: a detector constructed and arranged to determine a property associated with the nanowire.

3. The article as in claim 1, wherein the sample exposure region comprises a microchannel.

4. The article as in claim 1, wherein the sample exposure region comprises a well.

5. The article as in claim 1, wherein the nanowire is a semiconductor nanowire.

6. The article as in claim 5, wherein the semiconductor nanowire is a silicon nanowire.

7. The article as in claim 5, wherein the semiconductor nanowire contains a P-N junction.

8. The article as in claim 5, wherein the semiconductor nanowire contains multiple p- n junctions.

9. The article as in claim 5, wherein the semiconductor nanowire is one of plurality of nanowires wherein each of the plurality of nanowires is doped with different concentrations of a dopant.

10. The article as in claim 1, wherein the nanowire is a carbon nanotube.

11. The article as in claim 10, wherein the nanotube is a single-walled nanotube.

12. The article as in claim 10, wherein the nanotube is a multi-walled nanotube.

13. The article as in claim 1, wherein the nanowire is an unmodified nanowire.

14. The article as in claim 24, wherein the reaction entity comprises a binding partner of the analyte.

15. The article as in claim 14, wherein the binding partner is non-specific.

16. The article as in claim 14, wherein the binding partner is specific.

17. The article as in claim 14, wherein the binding partner comprises chemical group on the nanowire surface, wherein the combined selected from groups consisting of –OH, -CHO, -COOH, $-SO_3H$, -CN, $-NH_2$, -SH, -COSH, COOR, Halide.

18. The article as in claim 14, wherein the binding partner comprises a specific biomolecular receptor selected from the group consisting of DNA, fragments of a DNA, antibody, antigen, protein, and enzyme.

19. The article as in claim 14, wherein the binding partner comprises short polymer chains grafted on the nanowire surface, wherein the chains are selected form a group of polymers consisting of: polyamide, polyester, polyacrylic, polyimide.

20. The article as in claim 14, wherein the binding partner comprises a thin hydrogel layer coated on the surface of the nanowire.

21. The article as in claim 14, wherein the binding partner comprises a thin coating on the surface of nanowires, wherein the coating is selected form the group consisting of oxides, sulfides and selenides.

22. The article as in claim 1, wherein the nanowire comprises a chemical-gated nanowire field effect transistor wherein an electrical characteristic of the nanowire is sensitive to a chemical change on a surface of the nanowire.

23. The article as in claim 1, wherein the nanowire comprises a material selected from the group consisting of an electroluminescent material, a photoluminescent material, and a diode, wherein a light emitting property of the nanowire is sensitive to a chemical change on a surface of the nanowire.

24. The article as in claim 1, further comprising a reaction entity positioned relative to the nanowire such that an interaction between the reaction entity and an analyte in the sample causes a detectable change in a property of the nanowire.

25. The article as in claim 24, wherein the reaction entity is selected from the group consisting of a nucleic acid, an antibody, a sugar, a carbohydrate, and a protein.

26. The article as in claim 24, wherein the reaction entity comprises a catalyst.

27. The article as in claim 24, wherein the reaction entity comprises a quantum dot.

28. The article as in claim 24, wherein the reaction entity comprises a polymer.

29. The article as in claim 24, wherein the reaction entity is fastened to the nanowire.

30. The article as in claim 24, wherein the reaction entity is positioned within 5 nanometers of the nanowire.

31. The article as in claim 24, wherein the reaction entity is positioned within 3 nanometers of the nanowire.

32. The article as in claim 24, wherein the reaction entity is positioned within 1 nanometer of the nanowire.

33. The article as in claim 24, wherein the reaction entity is attached to the nanowire through a linker.

34. The article as in claim 24, wherein the reaction entity is attached to the nanowire directly.

35. The article as in claim 24, wherein the reaction entity is positioned relative to the nanowire such that it is electrically coupled to the nanowire wherein a detectable interaction between an analyte in the sample and the reaction entity causes a detectable change in an electrical property of the nanowire.

36. An article as in claim 3, wherein the microchannel has a minimum lateral dimension less than 1 mm.

37. The article of claim 3, wherein the microchannel has a minimum lateral dimension less than 0.5 mm.

38. The article of claim 3, wherein the microchannel has a minimum lateral dimension less than 200 microns.

39. The article as in claim 1, wherein the nanowire is one of a plurality of nanowires comprising a sensor.

40. The article as in claim 39, wherein each of the plurality of the nanowires includes at least one portion positioned in the sample exposure region.

41. The article as in claim 39, wherein the plurality of nanowires comprises at least 10 nanowires.

42. The article as in claim 41, wherein the multiple nanowires are arranged in parallel and addressed by a single pair of the electrodes.

43. The article as in claim 41, wherein the multiple nanowires are arranged in parallel to each other and addressed individually by multiple pairs of electrodes.

44. The article as in claim 43, wherein the multiple nanowires are different, each capable of detecting a different analyte.

45. The article as in claim 41, wherein the multiple nanowires are oriented randomly.

46. The article as in claim 1, wherein the nanowire is positioned on the surface of a substrate.

47. The article as in claim 1, wherein the sample exposure region comprises a microchannel and the nanowire is suspended in the microchannel.

48. The article as in claim 1, where the article is one of a plurality of nanowire sensors in a sensor array formed on a surface of a substrate.

49. The article as in claim 48, wherein the substrate is selected from the group consisting of glass, silicon dioxide-coated silicon and a polymer.

50. The article as in claim 3, wherein the microchannel is dimensioned so as to produce a Reynolds number (Re) less than about 1 for a fluid comprising the sample.

51. The article as in claim 42, wherein the Reynolds number is less than about 0.01.

52. The article as in claim 1, constructed and arranged to receive a fluidic sample in the sample exposure region.

53. The article as in claim 44 wherein the sample is a gas stream.

54. The article as in claim 44, wherein the sample is a liquid.

55. The article as in claim 1, wherein the article comprises a plurality of nanowires and a plurality of reaction entities, at least some of which are positioned relative to the nanowires such that an interaction between the reaction entity and an analyte causes a detectable change in a property of a nanowire.

56. The article as in claim 55, wherein at least one reaction entity is positioned within 100 nanometers of a nanowire.

57. The article as in claim 55, wherein at least one reaction entity is positioned within 50 nanometers of a nanowire.

58. The article as in claim 55, wherein at least one reaction entity is positioned within 10 nanometers of a nanowire.

59. The article as in claim 1, where in the sample exposure region is addressable by a biological sample.

60. The article as in claim 1, where the article forms sensing elements for a micro-needle probe.

61. The article as in claim 60, wherein the micro-needle is implantable into a living subject.

62. The article as in claim 60, wherein the article is a sensor capable of monitoring a physiological characteristic.

63. The article as in claim 60, wherein the sensor is capable of monitoring a plurality of physiological characteristics.

64. The article as in claim 60, wherein the article is capable of simultaneously monitoring a plurality of physiological characteristics.

65. The article as in claim 60, wherein the article is capable of determining at least one of oxygen concentration, carbon dioxide concentration, and glucose level in a subject.

66. The article as in claim 1, where the article forms sensing elements for an integrated dip-probe sensor.

67. The article as in claim 1, where the article forms sensing elements for a plug and play sensor array.

68. The article as in claim 2, wherein the article is capable of delivering a stimulus to the nanowire and the detector is constructed and arranged to determine a signal resulting from the stimulus.

69. The article as in claim 68, wherein the stimulus is selected from the group consisting of constant current/voltage, an alternating voltage, and electromagnetic radiation.

70. The article as in claim 2, wherein the detector is constructed and arranged to determine an electrical property associated with the nanowire.

71. The article as in claim 2, wherein the detector is constructed and arranged to determine a change in an electromagnetic property associated with a nanowire.

72. The article as in claim 2, where the detector is constructed and arranged to determine a change in a light emission property associated with the nanowire.

73. A method comprising:

contacting a nanowire with a sample suspected of containing an analyte; and determining a change in a property of the nanowire.

74. The method as in claim 73, comprising first measuring a property of the nanowire, then contacting the nanowire with the sample, then determining a change in a property associated with the nanowire.

75. A method comprising:

providing an nanowire and contacting the nanowire with a sample having a volume of less than about 10 microliters; and

measuring a change in a property of the nanowire resultant from the contact.

76. A method comprising:

contacting a nanowire with a sample suspected of containing an analyte and determining the presence or quantity of the analyte by measuring a change in a property of the nanowire resulting from the contact, wherein less than ten molecules of the analyte contribute to the change in the property detected.

77. The method of claim 76, wherein less than 5 molecules of the species contribute to the change in electrical property.

78. The method of claim 77, wherein one molecule of the species contributes to the change in electrical property detected.

79. An article comprising:

a sample cassette comprising a sample exposure region and a nanowire, at least a portion of which is addressable by a sample in the sample exposure region, wherein the sample cassette is operatively connectable to a detector apparatus able to determine a property associated with the nanowire.

80. A sensor comprising:

at least one nanowire; and

means for measuring a change in a property of the at least one nanowire.

81. A method of detecting an analyte, comprising:

contacting a nanowire with a sample; and

determining a property associated with the nanowire where a change in the property when the nanowire is contacted with the sample indicates the presence or quantity of the analyte in the sample.

82. A method comprising:

contacting an electrical conductor with a sample; and

determining the presence or quantity of an analyte in the sample by measuring a change in a property of the conductor resultant from the contact, wherein less than ten molecules of the analyte contribute to the a change in said property.

83. An article comprising:

a nanowires core region and an outer region, wherein outer region comprises functional moieties which are chemically or physically bonded to the nanowire core.

84. The article as in claim 83, wherein the core is a semiconductor nanowire, comprising material selected from the group consisting of: Si, GaN, AlN, InN, GaAs, AlAs, InAs, InP, GaP, SiC, CdSe, ZnSe, ZnTe, ZnO, SnO_2, and TiO_2.

85. The article as in claim 83, wherein the nanowire core has a diameter ranging from 0.5 nm to 200 nm.

86. The article as in claim 83, wherein the nanowire core has an aspect ratio more than 2.

87. The article as in claim 83, wherein the functional moieties at the outer region are groups or combinational groups selected from the groups consisting of –OH, -CHO, -COOH, $-SO_3H$, -CN, $-NH_2$, -SH, -COSH, COOR, and halide.

88. The article as in claim 83, wherein, the functional moieties are groups selected from the group consisting of amino acids, proteins, DNA, antibodies, antigens, and enzymes.

89. The article as in claim 83, wherein the functional moieties comprise grafted polymer chains with chain length less than the diameter of the nanowire core, selected from a group of polymers including polyamide, polyester, polyimide, polyacrylic.

90. The article as in claim 83, where the functional moieties comprise a thin coating covering the surface of the nanowire core, selected from the group consisting of metals, semiconductors, and insulators.

91. The article as in claim 90, wherein the coating is selected from the group consisting of a metallic element, anoxide, a sulfide, a nitride, a selenide, a polymer, and a polymer gel.

92. A nanowire sensor device, comprising

a semiconductor nanowire having a first end in electrical contact with a conductor to form a source electrode, a second end in electrical contact with a conductor to form a drain electrode, and an exterior surface having an oxide formed thereon to form a gate electrode, and

a binding agent having specificity for a selected moiety and being bound to the exterior surface, whereby a voltage at the gate electrode varies in response to the binding of the moiety to the binding agent to provide a chemically gated field effect sensor device.

93. A analyte-gated field effect transistor having a predetermined current-voltage characteristic and adapted for use as a chemical or biological sensor, comprising:

(a) a substrate formed of a first insulating material;

(b) a source electrode disposed on the substrate;

(c) a drain electrode disposed on the substrate,

(c) a semiconductor nanowire disposed between the source and drain electrodes to form a field effect transistor having a predetermined current-voltage characteristic; and

(d) an analyte-specific binding agent disposed on a surface of the nanowire, wherein a binding event occurring between a target analyte and the binding agent causes a detectable change in the current-voltage characteristic of said field effect transistor.

94. The analyte-gated field effect transistor of claim 93, wherein the analyte is a chemical moiety.

95. The analyte-gated field effect transistor of claim 94, wherein the chemical moiety is a small organic compound.

96. The analyte-gated field effect transistor of claim 94, wherein the chemical moiety is an ion.

97. The analyte-gated field effect transistor of claim 93, wherein the analyte is a biological moiety.

98. The analyte-gated field effect transistor of claim 97, wherein the analyte is selected from the group consisting of proteins, nucleic acid, carbohydrates, lipids, and steroids.

99. An article comprising array of at least 100 of said analyte-gated field effect transistor of claim 93.

100. The article of claim 99, which is homogenous with respect to a population of analyte-specific binding agents associated with the article.

101. The article of claim 99, which is heterologous with respect to a population of analyte-specific binding agents associated with the article.

102. The article as in claim 24, wherein the reaction entity is positioned relative to the nanowires such that it is optically coupled to the nanowire wherein a detectable interaction between an analyte in the sample and the reaction entity causes a detectable change in a property of the nanowire.